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Swelling behavior of polyvinyl alcohol and lactic acid hydrogel films

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Hydrogel films are the thin-film formation that can absorb the water or biological fluids shown as hydrated polymer gels. Hydrogel films have a potential as carriers for bioactive macromolecules, wound dressing, and controlled drug release. Polyvinyl alcohol (PVA) is a biodegradable and biocompatible synthetic polymer which has been widely used in pharmaceutical fields. This work aims to study the swelling behavior of hydrogel films prepared from PVA and lactic acid (LA) intended to use as drug delivery system.

Five grams of PVA were dissolved in hot water until clear solution and then slowly mixed with 7.5 g of LA solution at room temperature. Subsequently, the mixture was cured in a hot oven at 100 °C for different curing times. The hydrogel films were determined for the swelling behaviors in the solution of chloride salts (10 mmol/L NaCl and KCl), and aqueous solution with various pHs (pH 2, 4, 7, and 10). The equilibrated swollen hydrogel films were weighted and calculated as the increasing weight compared to the initial weight of hydrogel films. The swelling ratio measurement of hydrogel films was investigated as shown in Fig. 1 (left). The swelling ratio in saline solutions significantly decreased from Na^+ to K^+. This was due to the size of the ion, the large ion is more difficult than small ion to penetrate into the hydrogel films [1]. This phenomenon can be described by Flory's equation that has been reported and published elsewhere [2]. In addition, when the mixing time and curing time increased, the swelling ratio was clearly decreased. The hydrogel films might be increased strong and hard films [3]. The swelling behavior of hydrogel films in different pH solutions showed that the hydrogel films highly swelled at pH 7. The selected PM8 hydrogel film was hydrated in distilled water at room temperature and then freeze-dried. The cross-section morphology by SEM technique is shown in Fig. 1 (right). Obviously, the hydrogel film showed a coarse and undulant surface. Thus, the water could easily penetrate

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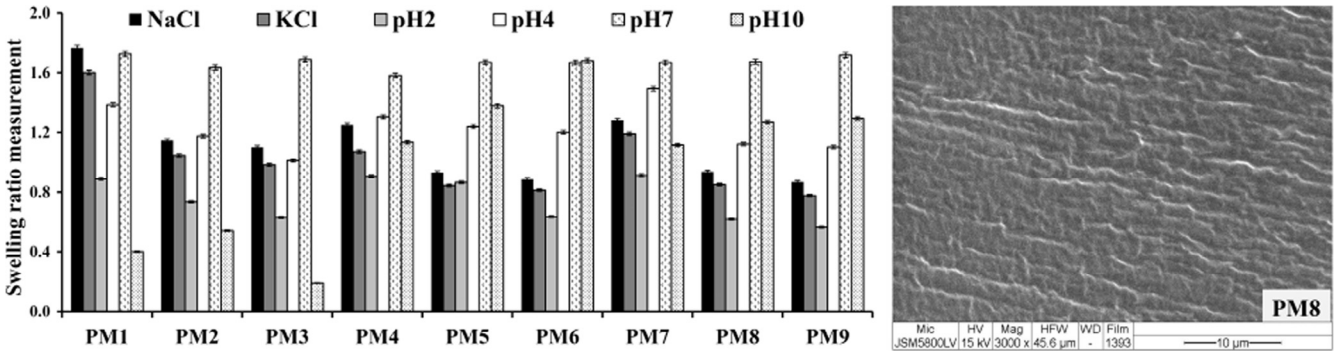

Fig. 1 – Swelling ratio measurement of hydrogel films (left) and the cross section morphology of PM8 hydrogel films (right): PM1, 2, 3 mixed for 30 min, PM4, 5, 6 mixed time for 60 min, and PM7, 8, 9 mixed for 90 min with curing time for 120, 150, and 180 min, respectively.

into the hydrogel film structure. Thus, the hydrogel films could be easily prepared from PVA and LA, which had good swelling properties and good water absorbency. In conclusion, this research supported the preparation of pharmaceutical formulation for drug delivery systems such as buccal film and transdermal patches.

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